NON-PUBLIC?: N
ACCESSION #: 9011020028
LICENSEE EVENT REPORT (LER)

FACILITY NAME: SAN ONOFRE NUCLEAR GENERATING STATION, PAGE: 1 OF 08
UNIT 1

DOCKET NUMBER: 05000206

TITLE: REACTOR TRIP ON A SPURIOUS LOW REACTOR COOLANT SYSTEM FLOW SIGNAL
EVENT DATE: 04/30/90 LER #: 90-007-01 REPORT DATE: 10/23/90

OTHER FACILITIES INVOLVED: NONE DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 091

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: R. W. Krieger, Station Manager TELEPHONE: (714) 368-6255

COMPONENT FAILURE DESCRIPTION:
CAUSE: B SYSTEM: JC COMPONENT: FT MANUFACTURER: F180
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

At 2202 on 4/30/90, with Unit 1 at 91% power, a reactor trip occurred due to actuation of the Reactor Protection System (RPS) on a spurious low Reactor Coolant System (RCS) flow signal in loop B. All systems responded normally to the trip and the operators stabilized the plant in Mode 3. The RPS operated in accordance with design with no malfunctions noted; therefore there was no safety significance to this event.

The root cause of this event is believed to be the existence of voids in the loop B RCS flow transmitter coil insulation, which caused a ground in the coil. It has been determined that the voids were due to an isolated manufacturing defect.

SCE believes that the ground in the flow transmitter coil caused the

instrument loop to be sensitive to the presence of magnetic fields adjacent to the instrument loop cables. The occurrence of a magnetic field, which could be caused by the normal operation of plant equipment, near the flow transmitter signal cable (or a steady magnetic field if the ground was intermittent) could have produced a noise pulse large enough and of sufficient duration to cause an induced current in the flow instrumentation circuit sufficient t
actuate the low flow trip signal,
thereby causing the reactor trip.

Corrective actions included replacement of the defective transmitter and verifying that all RCS loop flow instruments were operating properly.

END OF ABSTRACT

Plant: San Onofre Nuclear Generating Station
Unit: On
Reactor Vendor: Westinghouse
Event Date: 04-30-90
Time: 2202

A. CONDITIONS AT TIME OF THE EVENT:

Mode: 1, Power Operation

B. BACKGROUND INFORMATION:

The Reactor Protection System (RPS) JC! provides reactor trip functions to protect the core against Departure from Nucleate Boiling and the Reactor Coolant System (RCS)AB! against overpressurization. There are three RCS loops (A, B, and C), each containing a hot leg, steam generator SG!, Reactor Coolant Pump (RCP)P! (with associated circuit breaker BKR!), and a cold leg. The RPS generates a reactor trip on single loop loss of flow when flow in any loop is less than 85% of full flow, or when an RCP breaker opens. This trip is active when reactor power is above 49% of full power.

An elbow in the hot leg piping directs RCS flow up 60 degrees from horizontal into the steam generator. The change in direction of the flow creates a higher pressure against the bottom of the elbow and a lower pressure at the top of the elbow. Pressure sensing lines run from taps (at the top and bottom of each elbow) to a differential pressure measuring transmitter FT!. The transmitters sense a

pressure differential of between 0 and 198 inches of water and convert this measurement to a 10 to 50 milliamperes Direct Current (maDC) signal, respectively. The pressure sensing lines are approximately 6 and 10 feet long and consist primarily of stainless steel tubing. The signal is conducted from the transmitter by a 2-conductor instrument cable CBL1!. For RCS Loops A and B (Loop C was partially replaced by new cable in 1989, as reported in LER 89-021-01 (Docket No. 50-206)), two polyethylene insulated copper conductors are twisted together with a copper ground conductor and are surrounded by a copper braided shield which is covered with a black colored polyethylene jacket. The insulation on one of the conductors is colored black and the other is colored white. All conducting elements of the cable are tinned. The cables run from each transmitter inside a conduit CND! to a cable tray TY! and then from the tray through a containment penetration PEN! to the control room area. In the control room area the signal is processed to provide the operator with indication of 0 to 100% full flow and a low loop flow alarm.

C. DESCRIPTION OF THE EVENT:

1. Event:

At 2202 on 4/30/90, with Unit 1 at 91% power, a reactor trip occurred due to actuation of the RPS on a spurious low RCS flow signal. All systems responded normally to the trip and the operators (utility, licensed) stabilized the plant in Mode 3. As designed, all RCPs tripped during the reactor trip.

2. Inoperable Structures, Systems or Components that Contributed to the Event:

None.

3. Sequence of Events:

TIME ACTION

2202 Reactor trip on low RCS loop flow signal.

2211 Operators complete trip response actions.

2223 All RCPs were restarted and operated normally. All RCS Loop flow indications were normal.

4. Method of Discovery:

Control room alarms and indications alerted the operators of the reactor trip.

5. Personnel Actions and Analysis of Actions:

The operators responded properly to the reactor trip and stabilized plant conditions utilizing applicable procedures. The operators also responded properly by restarting the RCPs and subsequently verifying that RCS flow indications were normal.

6. Safety System Responses:

The RPS operated in accordance with design, with no malfunctions noted.

D. CAUSE OF THE EVENT:

1. Immediate Cause:

The RPS initiated a reactor trip on low RCS flow as recorded in the Event Recorder and "first out" alarm status. "First out" alarm status refers to the first alarm recorded in chronological order of occurrence. The Event Recorder showed that the trip condition existed briefly, indicative of a spike of the loss of flow signal. When the RCPs were restarted per procedure, all three loop flow indicators responded normally, indicating 100% flow. Since the response was normal and the individual loop flows are not recorded (which would have provided flow values prior to the trip) a determination of which RCS loop(s) initiated the loss of flow signal could not be made at the time of the event.

2. Root Cause:

The root cause of this event is believed to be the existence of voids in the loop B RCS flow transmitter coil insulation, which caused a ground in the coil. It has been determined that the voids were due to an isolated manufacturing defect.

SCE believes that the ground in the flow transmitter coil

caused the instrument loop to be sensitive to the presence of magnetic fields adjacent to the instrument loop cables. The occurrence of a magnetic field, which could be caused by the normal operation of plant equipment, near the flow transmitter signal cable (or a steady magnetic field if the ground was intermittent) could have produced a noise pulse large enough and of sufficient duration to cause an induced current in the flow instrumentation circuit sufficient to actuate the low flow trip signal thereby causing the reactor trip.

E. CORRECTIVE ACTIONS:

1. Corrective Actions Taken:

a) The defective flow transmitter was replaced and sent to an offsite laboratory to determine the failure mechanism. The results of that failure analysis are described in Section D.2.

b) All RCS Loop flow instruments were verified to be operating properly.

c) In order to determine if this condition was an isolated manufacturing defect, the following was performed:

1) A search of NPRDS was performed to check for similar transmitter failures. The search revealed 10 events, but none of the failure modes listed were due to grounds.

2) The transmitter manufacturer was contacted to determine if other failures due to grounds had occurred. The manufacturer indicated that there were no previous failures of transmitters due to grounds associated with the transmitter insulation.

It has been determined that the defect in the transmitter coil was an isolated manufacturing defect.

2. Planned Corrective Actions:

As noted in LER 1-89-021-01, the RCS Loop flow instrument cables and other similarly insulated cables are to be periodically tested using Electrical Characterization and

Diagnostic (ECAD) system or a similar system to assess cable insulation integrity. This testing will also provide an assessment of any instruments connected to the cables.

F. SAFETY SIGNIFICANCE OF THE EVENT:

There was no safety significance associated with the reactor trip since all safety and protective systems operated in accordance with their design.

G. ADDITIONAL INFORMATION:

1. Post Trip Investigation:

During the post-trip investigation, insulation degradation similar to that previously reported in LER 89-021-01 (Docket No. 50-206) was found in the loop A and B flow transmitter cables. The root cause investigation included an evaluation of the potential for this degradation causing the reactor trip. As discussed above in Section D.2, SCE has concluded that the trip was not caused by the transmitter cable insulation degradation, but most likely by a defect in the transmitter coil insulation. However, the following corrective actions were taken or are planned to address the cable insulation degradation:

a) The portion of the RCS loop flow transmitter cables with degraded insulation was replaced with cable suitable for the e
vironment.

b) The removed cable sections were sent to an independent offsite laboratory to determine the exact mechanism for the loss of insulation resistance on the cables. The failure analysis determined that the degraded insulation resulted from the same failure mechanism (loss of insulation resistance resulting from time-temperature-radiation exposure degradation of the polyethylene insulation) described in LER 89-021-01.

c) A review of Unit 1 electrical cables was performed using the following criteria to determine other cables susceptible to failure:

1) Cables located inside the bioshield.
2) Cables whose failure could cause or prevent a reactor trip.
3) Cables which are not environmentally qualified.
4) Cables which were not installed by a modification which would have used new cable.
5) Cable which does not have self revealing failure modes (e.g. power cables).

In order for a cable to be considered susceptible, all of the above criteria needed to be applicable.

As a result of this review, none of the cables identified could prevent a reactor trip. However, the failure of any one of three cables which are associated with the Steam Generator Narrow Range (SGNR) Level Transmitters could potentially cause a reactor trip and, therefore, were ECAD tested with satisfactory results.

d) The RCS loop flow and the SGNR level transmitter cables which are located in containment are being completely replaced during the current thermal shield support repair outage.

e) As described in LER 89-021-01, a limited number of cables with the same cable code (type) remain in service at Unit 1 in important to safety applications. A sample of these cables will be tested at the next refueling outage to determine their insulation integrity. None of these applications (including RCS loop flow instrumentation) require that the cables be Environmentally Qualified.

Also, at the time of the reactor trip, a maintenance technician (utility, unlicensed) was in the process of removing a pressurizer temperature vapor space instrument module from its instrument rack. This module is located in the same instrument rack as the RCS loop flow instrument module for loop B. In order to determine if this work was somehow related to or caused the reactor trip, the actions that the technician was performing at the time of the reactor trip were duplicated. The trip signal could not be duplicated. SCE has determined that it is unlikely that the work in progress was a factor in the reactor trip.

2. Component Failure Information:

a) The failed flow transmitter is manufactured by Foxboro and is model number NE13DH with a range of 0-206 inches of water.

b) The RCS flow transmitter instrumentation cables are believed to have been manufactured by a company known only as "Rome Cable Corp". The cables were probably manufactured in the early to middle 1960's and were installed as part of the original plant construction (i.e., prior to 1968). No records have been identified which provide information about the manufacturer or the cables.

3. Previous LERs for Similar Events:

LER 87-008 (Docket No. 50-206)

On 6/2/87, with Unit 1 in Mode 5, meggering of Control Rod Drive Mechanism (CRDM) coil circuits revealed low insulation resistance in several circuits. The source of the low resistance was found to be in the Kapton insulated containment penetration electrical "pigtails". In several cases the insulation was found to be damaged, and in the balance of cases the insulation was damaged and the conductor corroded. As corrective action, the damaged "pigtails" were repaired and appropriate administrative controls implemented which would prevent insulation damage by work activities. Since the cause and corrective actions were applicable to mechanical damage of the kapton insulation at the containment penetrations, they could not have prevented insulation damage to the RCS Loop B flow transmitter coil.

LER 89-021-01 (Docket No. 50-206)

On 8/3/89, with Unit 1 at 91% power, a reactor trip occurred due to actuation of the RPS on low RCS flow in one loop. The brief loss of flow signal was caused by a loss of insulation resistance of the flow transmitter cable. Laboratory test results indicate that the insulation had become brittle due to oxidation. The cause of the insulation oxidation is attributed to time-temperature-radiation exposure to the cable. This loss of insulation resistance, plus moisture in the conduit

resulting from the installation of a temporary refueling water level indicator on the flow instrument, caused the RCS low flow signal, which in turn caused the reactor trip. As corrective action, the cable was replaced and the RCS Loop C flow instrument was verified to be operating properly. Also, the procedure which installs the temporary refueling water level indication was modified to preclude reoccurrence of moisture intrusion in the cable conduit. The other two RCS loop flow cables were tested satisfactorily at the time of the event and there was no indication of insulation degradation or grounds in the flow transmitter for RCS loop B flow instrument. Testing of other similarly insulated cables in containment will be performed on a periodic basis to access insulation integrity.

Southern California Edison Company

SAN ONOFRE NUCLEAR GENERATING STATION

P. O. BOX 128

SAN CLEMENTE, CALIFORNIA 92674-0128

R. W. KRIEGER TELEPHONE
STATION MANAGER (714) 368-6255

October 23, 1990

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: Docket No. 50-206
Supplemental Report
Licensee Event Report No. 90-007, Revision 1
San Onofre Nuclear Generating Station, Unit 1

Reference: Letter, H. E. Morgan (SCE) to USNRC Document Control Desk, dated May 30, 1990.

The referenced letter provided Licensee Event Report (LER) No. 90-007, (Revision 0), for an occurrence involving a Reactor Trip due to a spurious Loss of Reactor Coolant System Flow signal. The enclosed supplemental LER provides additional information concerning the root cause and corrective actions. Neither the health and safety of plant

personnel or the public was affected by this occurrence.

If you require any additional information, please so advise.

Sincerely,

Enclosure: LER No. 90-007, Rev. 1

cc: C. W. Caldwell (USNRC Senior Resident Inspector, Units 1, 2 and 3)
J. B. Martin (Regional Administrator, USNRC Region V)
Institute of Nuclear Power Operations (INPO)

*** END OF DOCUMENT ***